



Identifying a NRT Path to Assimilate Geostationary Aerosol Data

Arlindo da Silva*

arlindo.m.dasilva@nasa.gov

Global Model and Assimilation Office, Code 610.1

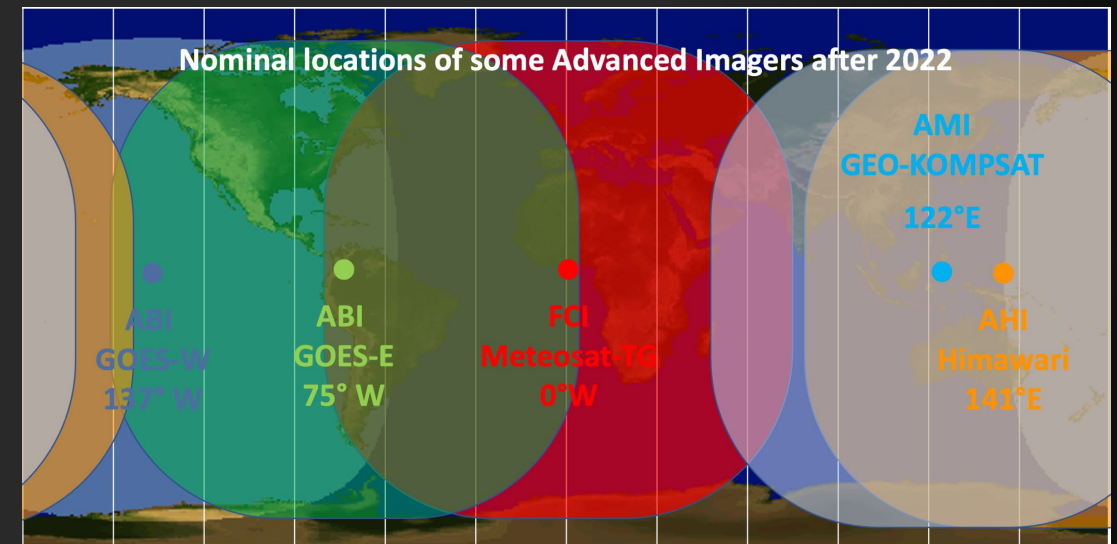
Last Presented at LANCE UWG Meeting

4 May 2022

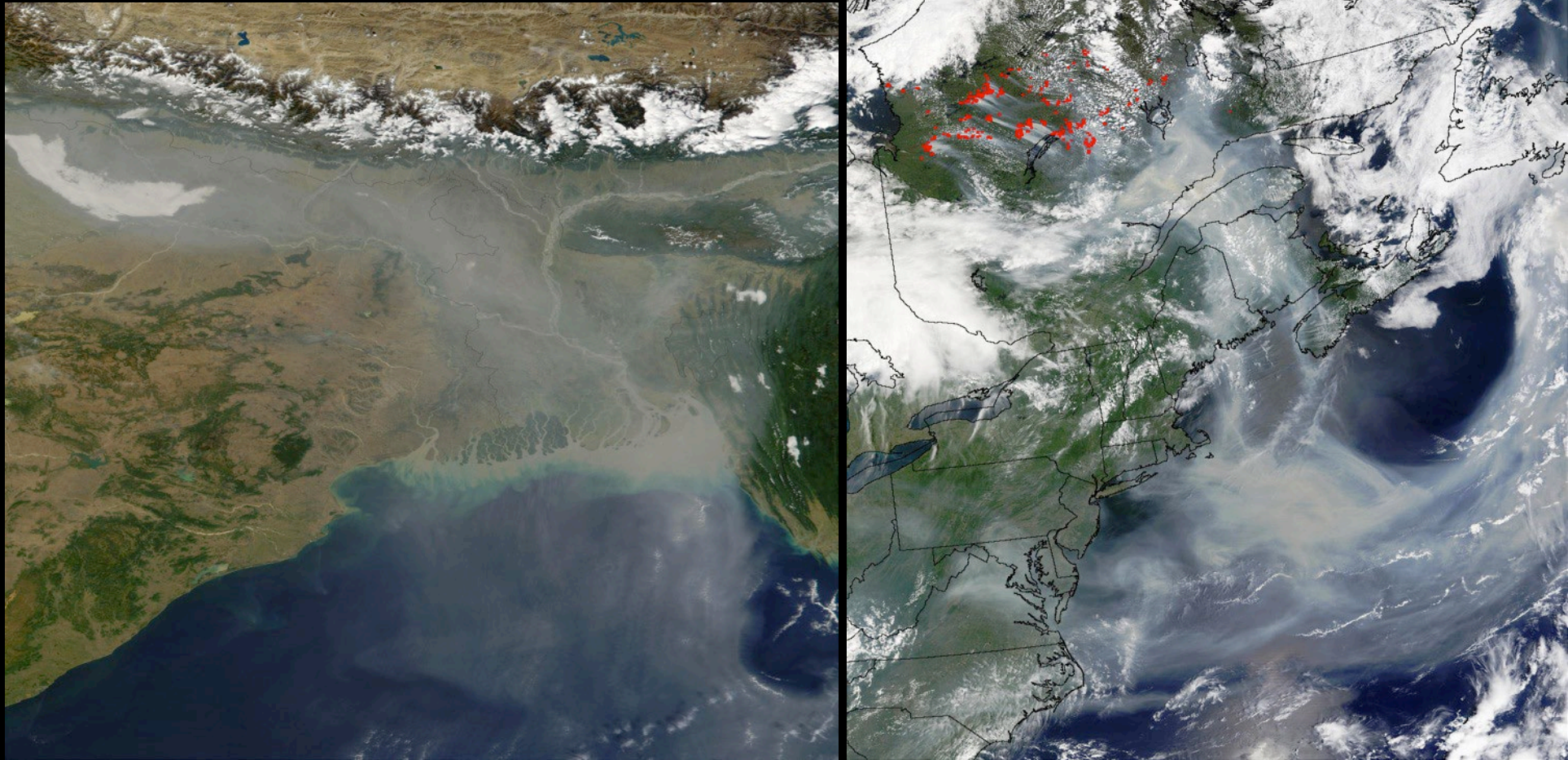
** With contributions from Rob Levy and Jeff Reid.*

Outline

- Dark Target aerosol algorithm:
MODIS, VIIRS, GEO
- Impact of geostationary data in
GEOS Aerosol DA System
- Need for NRT geostationary
aerosol data: feedback from
US/international community
- Possible path for NRT
geostationary aerosol retrievals



We can see haze and smoke from space



Haze over the Ganges/Bay of Bengal (4 December 2001)

Smoke transported over Eastern Canada/USA (8 July 2002)



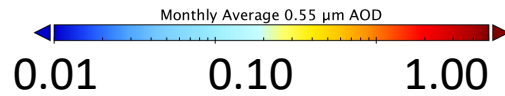
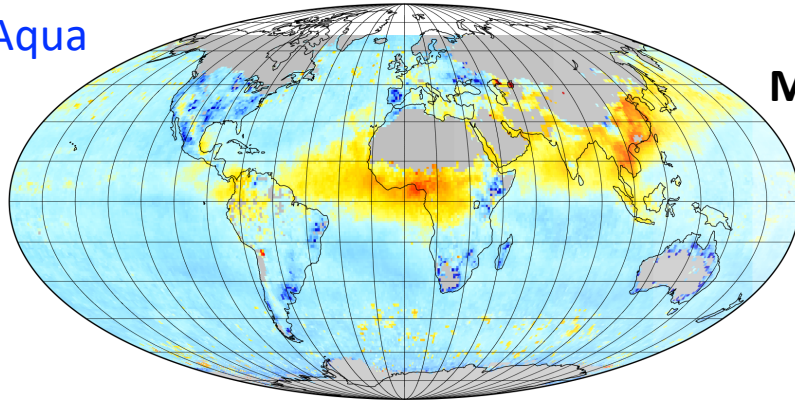
The Dark Target/Deep Blue Algorithms

MODIS-heritage Algorithms

MODIS + VIIRS --> Long term climate

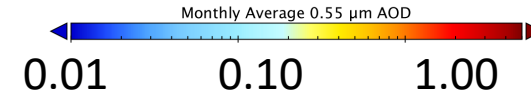
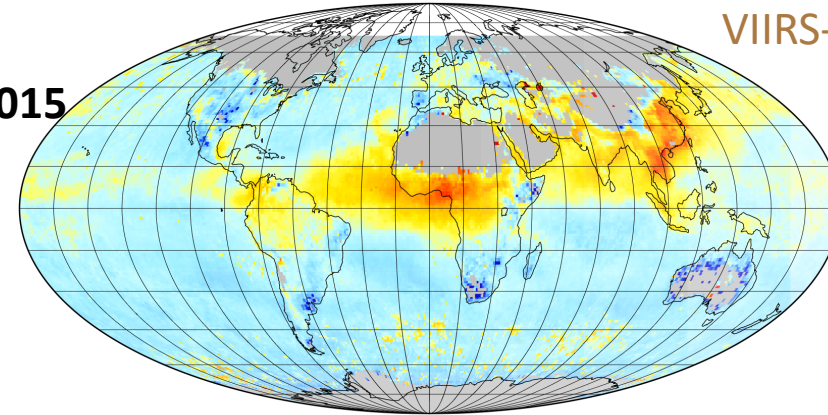
QA-Filtered Aerosol Optical Depth, MODIS Aqua C6.1, March 2015

MODIS-Aqua

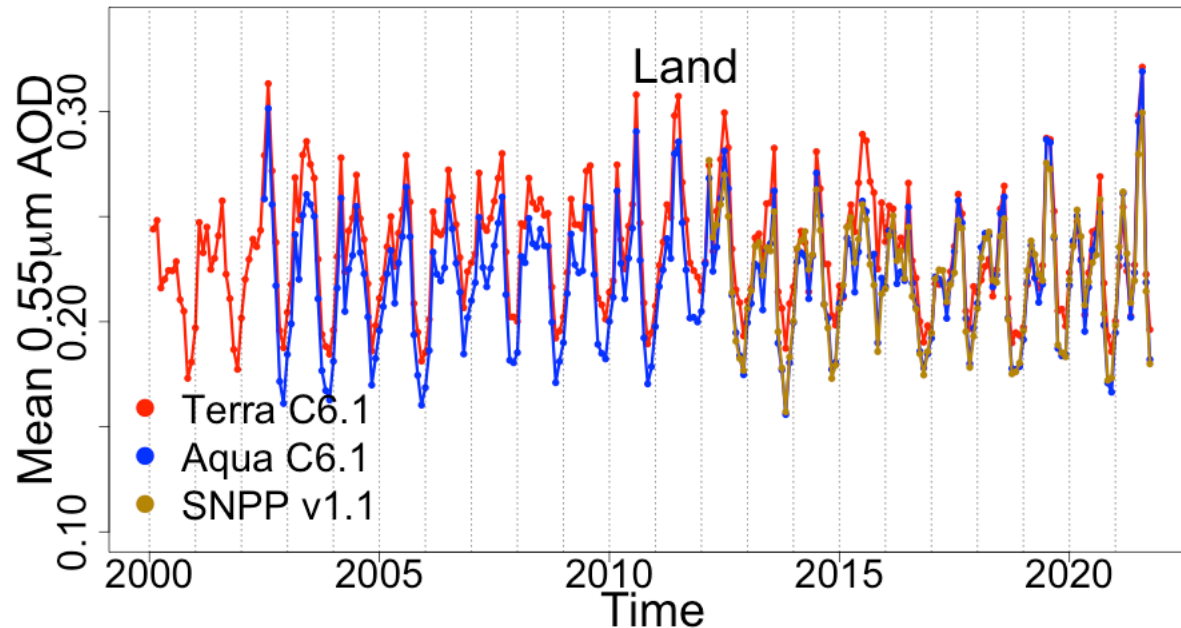


QA-Filtered Aerosol Optical Depth, VIIRS SNPP v1.1, March 2015

VIIRS-SNPP



March 2015



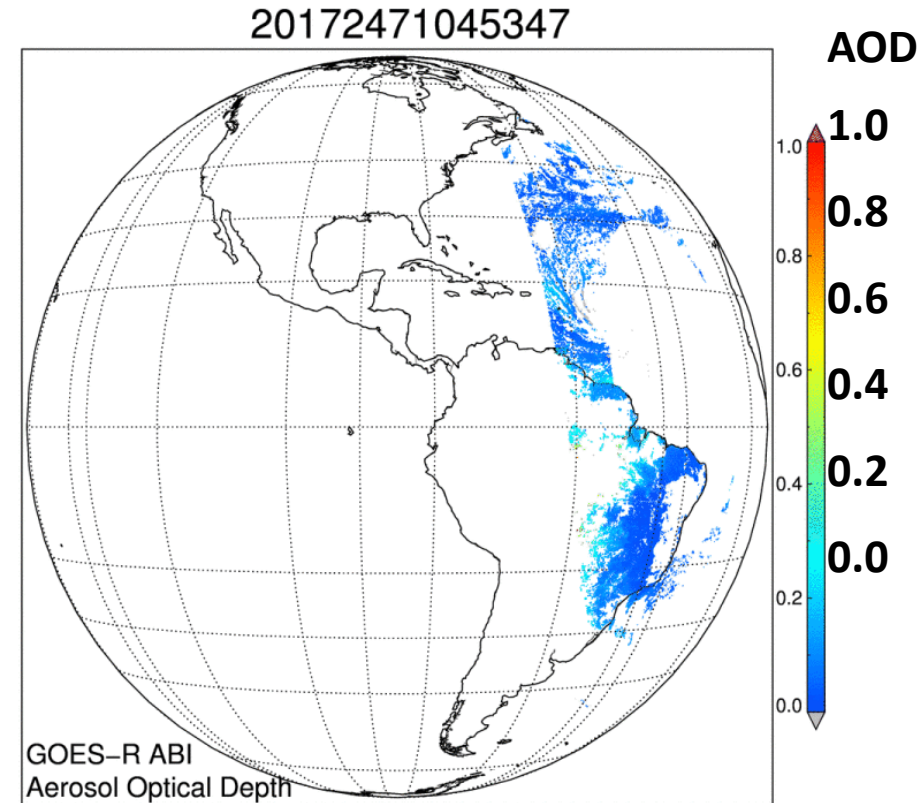
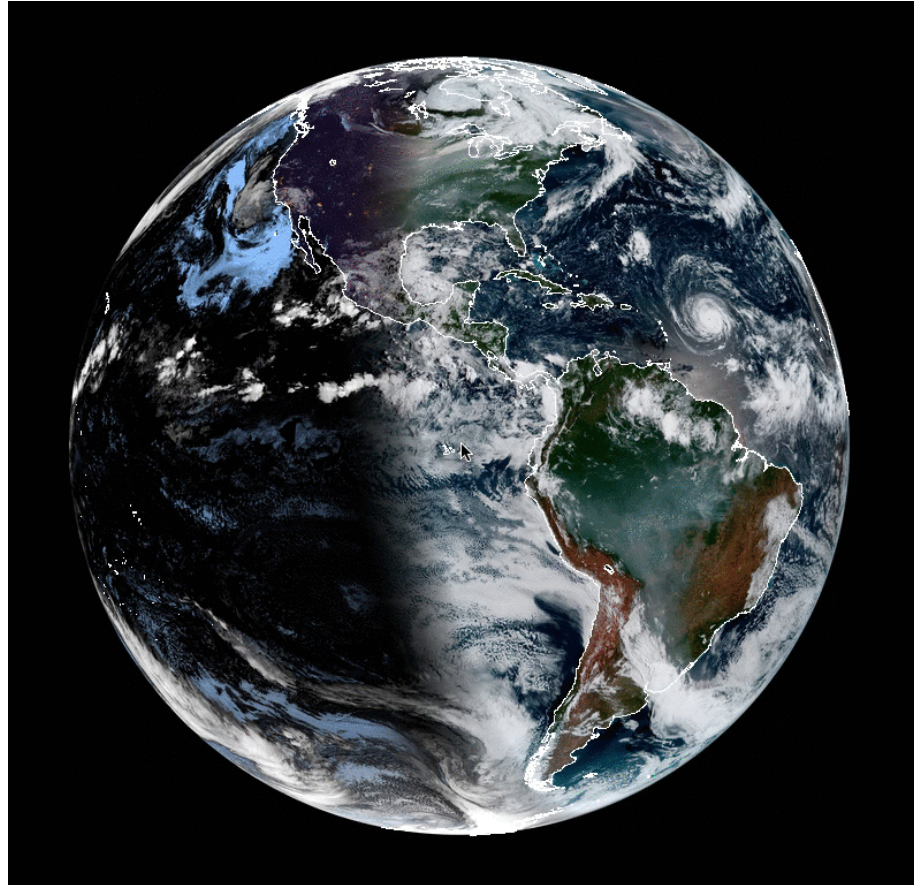
VIIRS-SNPP

MODIS-Aqua

“funded” to continue on VIIRS-JPSS-1/NOAA20 (≥2021)

Expanding to retrieve from GEO-Imager data!

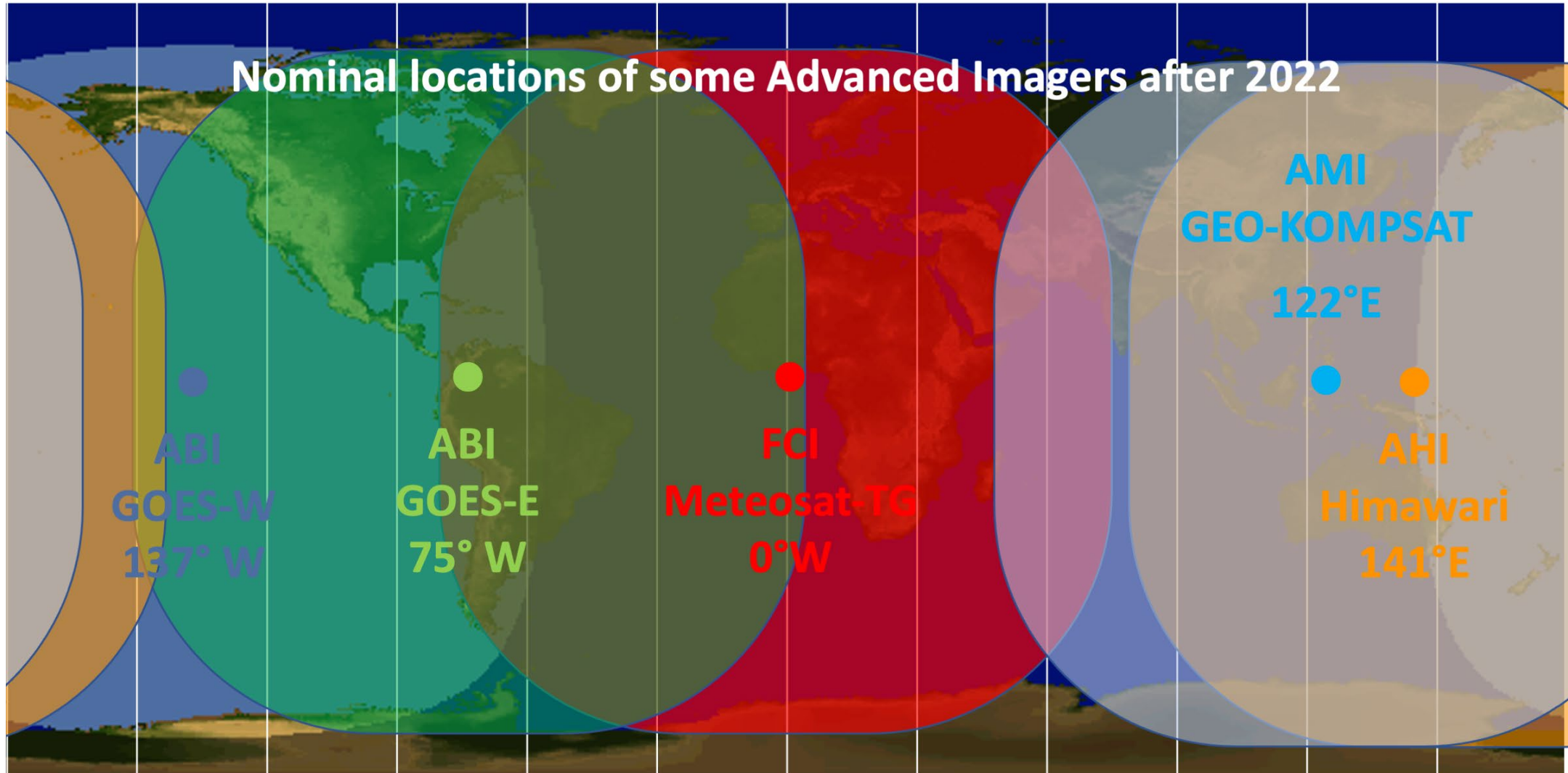
RGB and AOD from ABI for Sep 4, 2017 (animation)
Canada/Washington fires and smoke mega-event



ABI = Advanced Baseline Imager

- Polar Orbiting Satellites: 1-3 observations per day, per sensor, cannot resolve diurnal cycle
- Current Geostationary Satellites: Every 10 min (Full Disk). Can resolve time

With options for adding even more sensors!



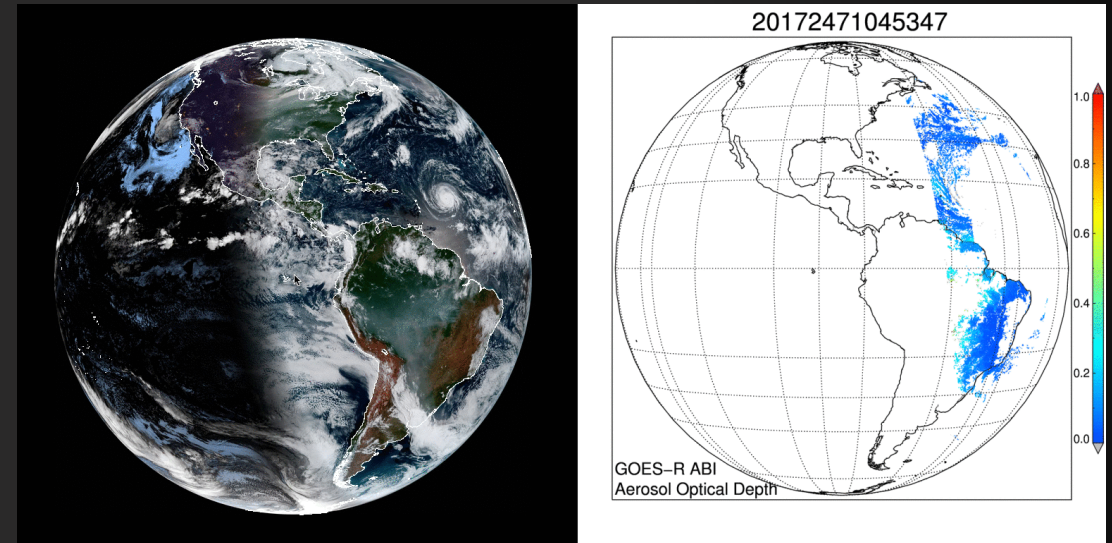
Status of Dark Target/Deep Blue Aerosol Products

- **MODIS Collection 6.1 ('MxD04_L2' and 'MxD04_3K')**
 - Data (2000-present) available in HDF4 format.
 - Includes Dark-Target / Deep Blue (DT/DB) merge product
 - Includes 3 km resolution product (MxD04_3K)
- **VIIRS Version 1.1 Dark-Target ('AERDT_VIIRS_SNPP')**
 - DT Data available in NetCDF4. Most output parameters same as MODIS
 - Deep Blue already ('AERDB') available since early 2019, and no current merge
 - Funded development for retrievals on NOAA-20 ('AERDT_VIIRS_N20')
- **Geostationary Beta product ('AERDT_ABI_G16', 'AERDT_ABI_G17', 'AERDT_AHI_H08')**
 - Data are being processed 2019-present (and some earlier data).
 - DT Data available in NetCDF4. Most output parameters same as VIIRS
 - Deep Blue already ('AERDB') in funded development and plans for merge

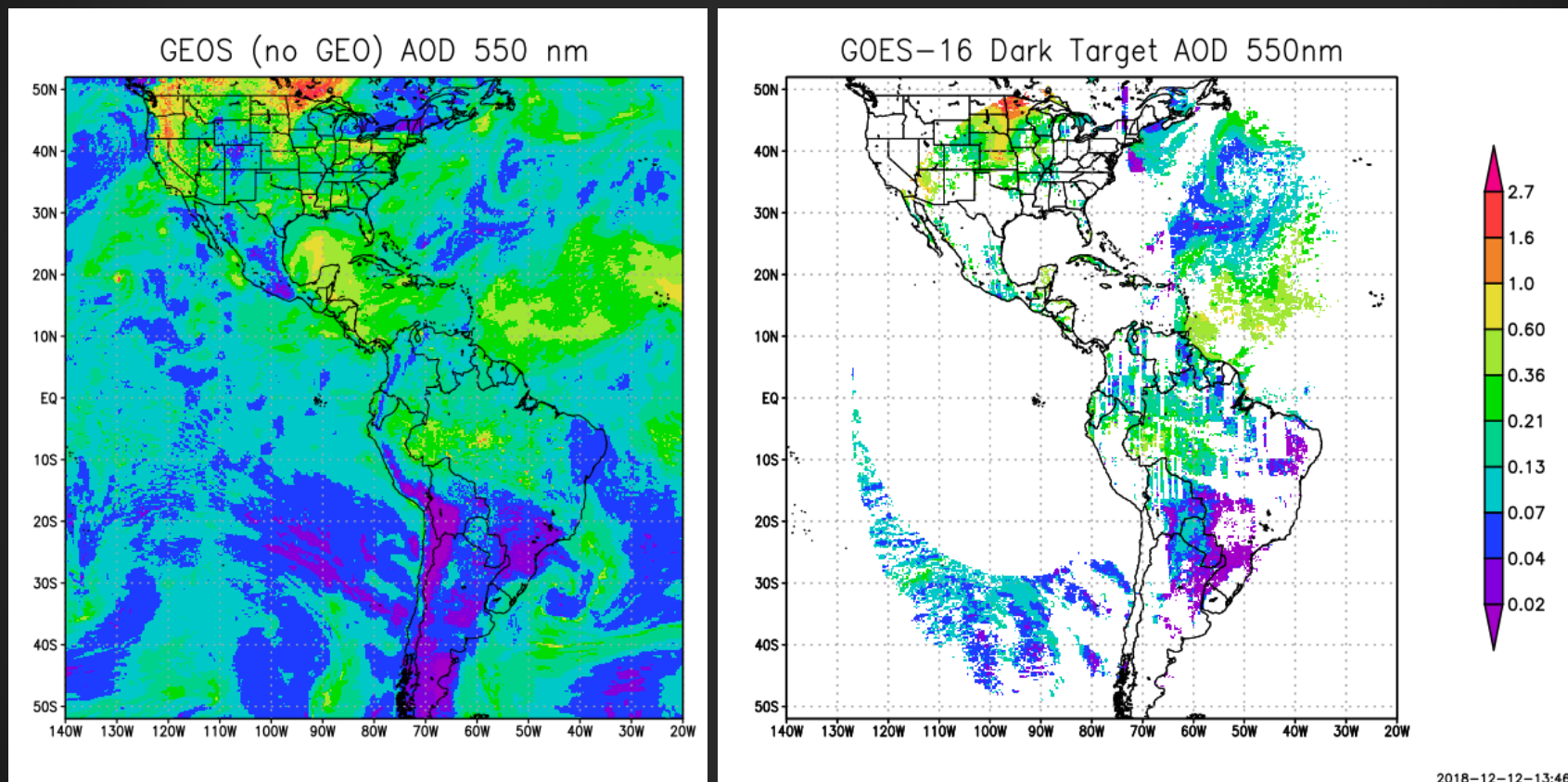
- **MODIS + VIIRS** Data currently available on LAADS.
 - <https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/science-domain/aerosol/>
- **GEO Beta** available by asking Rob Levy! (Open to public on LAADS after 2022)

Dark Target Products in GEOS

- MODIS DT/DeepBlue products are assimilated in GEOS NRT system (thanks, LANCE!) and in the MERRA-2 reanalysis; VIIRS in progress
- DT/Deep Blue products are very convenient for assimilation in GEOS
 - Provides *cloud cleared/gas corrected* reflectances used for the retrieval (at ~10 km product resolution)
 - Product files are in NetCDF/HDF format
 - Variable names similar to MODIS
- Currently testing ABI on GOES-16/17, and AHI on Himawari-8 in 2019 during FIREX-AQ and CAMP²EX airborne campaigns
- Observations of diurnal aerosol!

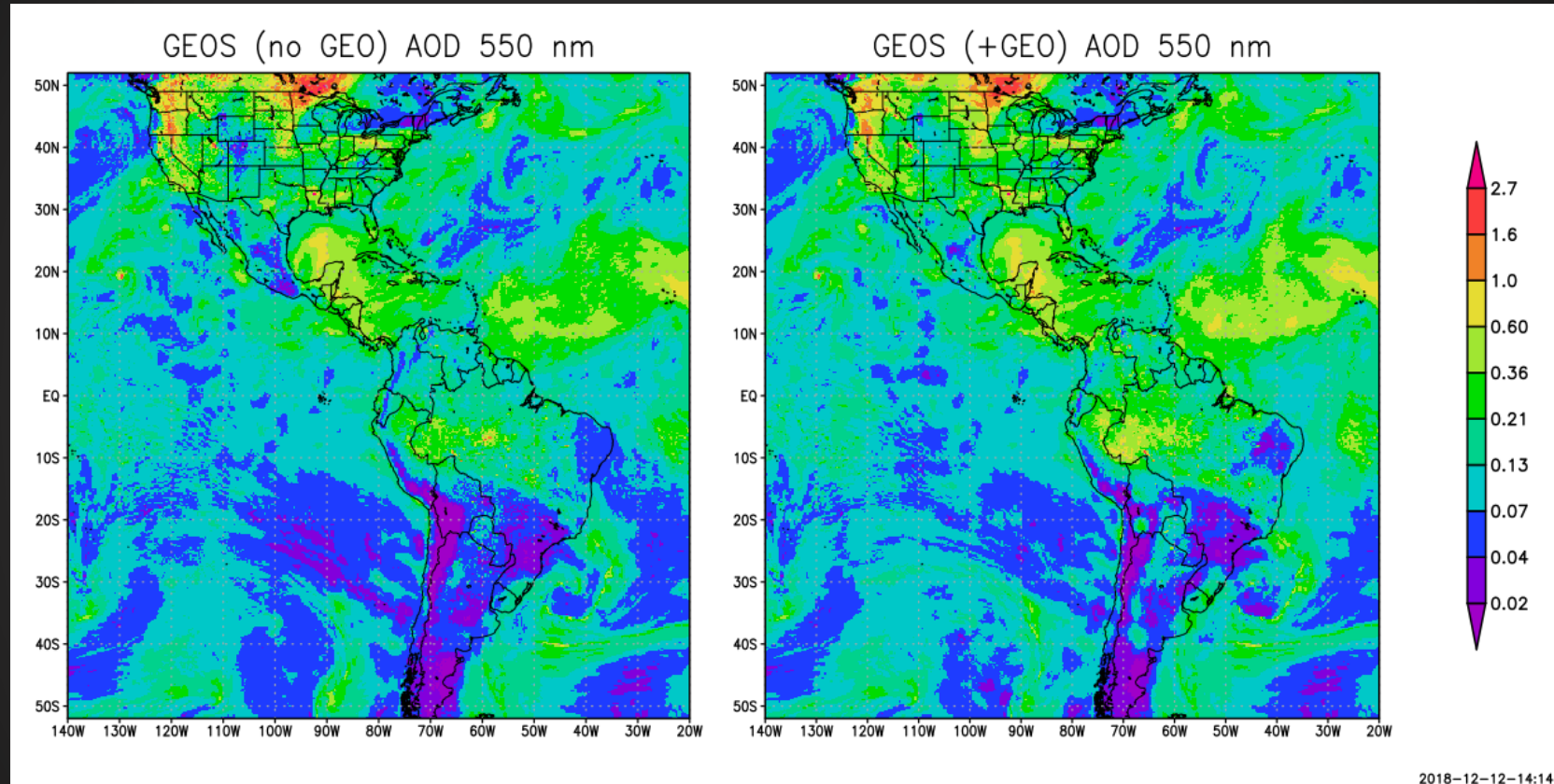


The before picture ...



Snapshot on 18Z 10Aug2018

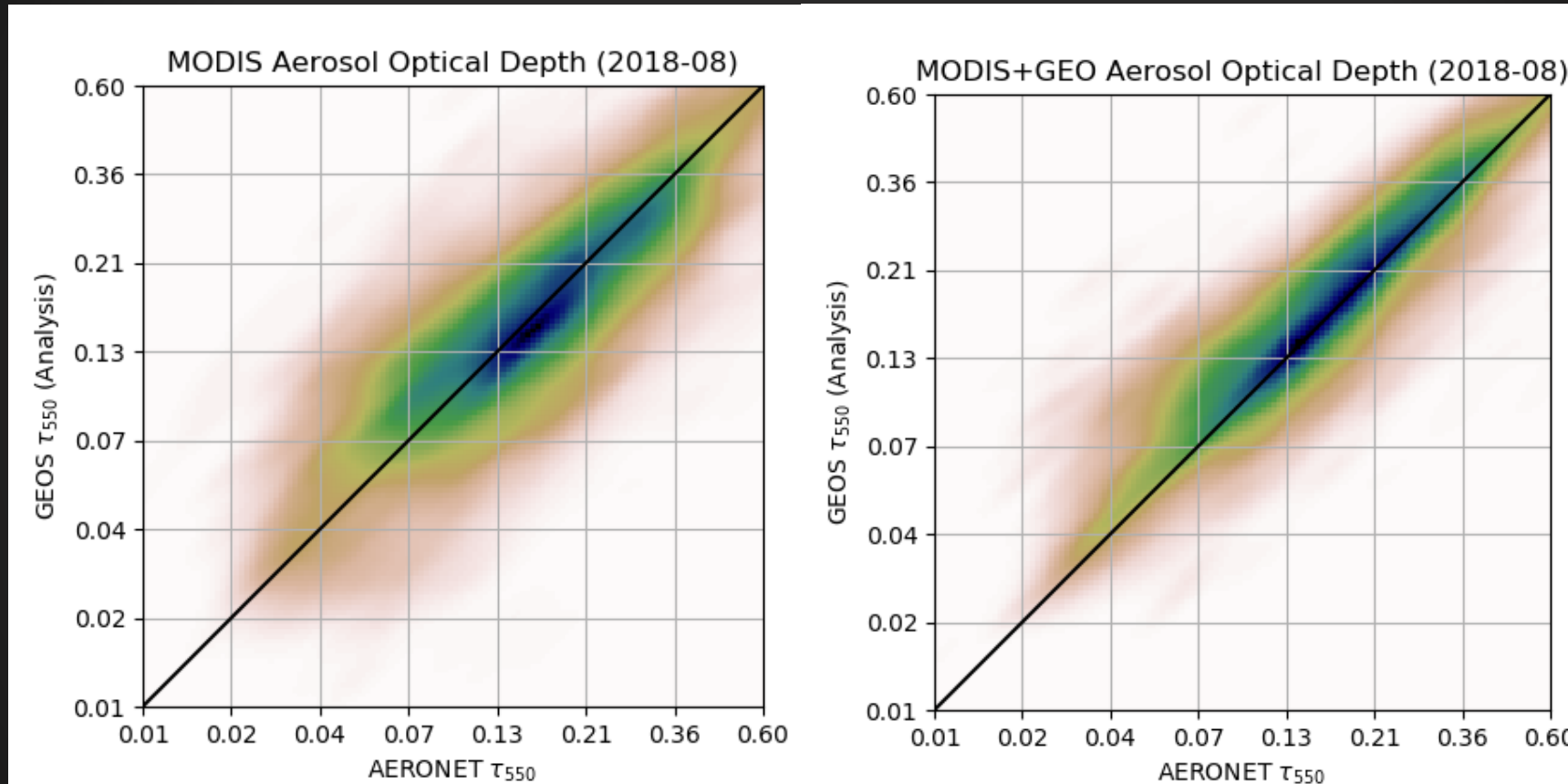
GEOS AOD analysis: the impact of ABI



Snapshot on 18Z 10Aug2018



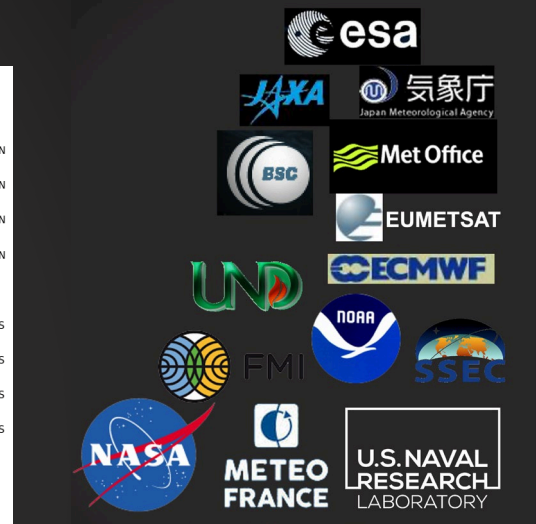
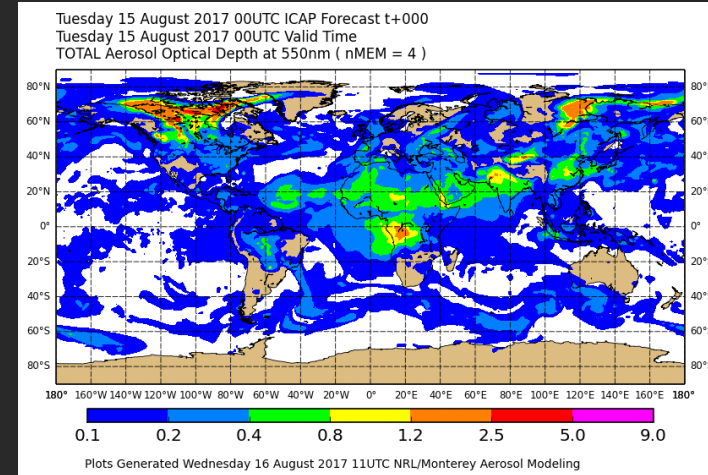
AERONET Verification



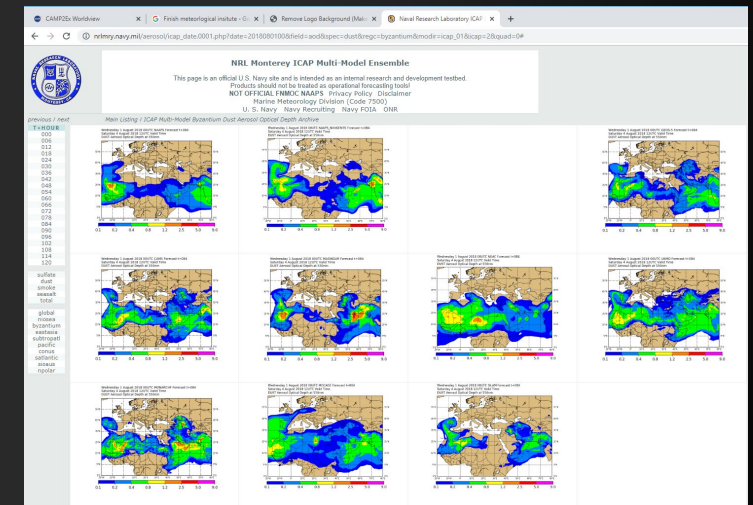
August 2018

International Cooperative for Aerosol Prediction

- By now, most major global centers have some form of NRT aerosol prediction
- Originated from a 2010 ad hoc meeting between model & remote sensing developers concerned with the transition from the MODIS to the VIIRS era. Discussions continue until today about all manner of aerosol modeling, remote sensing, and data assimilation problems.
- Given global reciprocity needs, developers agreed to begin collaborative aerosol research on satellite QA/QC, verification, and consensus/multi-model ensemble to diagnosing data requirements.
- ICAP members do not speak for their agencies, but ICAP allows developers to speak as a community to establish best practices and make scientific recommendations
- Model members: BSC, ECMWF, FMI, JMA, GMAO, MeteoFrance, NCEP, NRL, UKMO.
- Remote sensing members: JAXA/JMA, ESA, Eumetsat, NASA, SSEC



ICAP Multi-mode Ensemble





Feedback from ICAP Members

- From GMAO and the AOS Project:

Geostationary data is a critical portion of the GEOS aerosol observing system. Having this data in NRT will significantly benefit the generation of low latency Level 4 products for the AOS mission that are needed for applications.

--- Arlindo da Silva/Dalia Kirschbaum

- From ECMWF:

I think it would be amazing to have the geostationary retrievals on LANCE. Total support from our side.

--- Angela Benedetti

- From NRL:

I think the whole community has been waiting for this for a long time. I think NRL is close to operational implementation-we just needs a dataset.

--- Jeff Reid

- From JMA:

Aerosol retrievals from geostationary satellites are of great interest, since JMA's aerosol prediction uses JAXA's aerosol retrieval algorithm with Himawari-8.

--- Taichu Tanaka



Possible Path Forward

- Members of the US and international aerosol prediction community agree about the urgent need to add geostationary data in NRT
- Although other MODIS-heritage aerosol algorithms exist (*e.g.*, Deep Blue, MAIAC), the Dark Target algorithm offers the breadth of sensors and maturity for NRT implementation of geostationary aerosol retrievals
 - Over time, other algorithms could be integrated as well
- The University of Wisconsin/SSEC has access to ABI and AHI data in NRT and have experience deploying the Dark Target algorithm for LEO and GEO sensors.
 - Extension to Meteosat Third Generation, when launched in 2022, will provide much needed GEO-ring global coverage.
- Can LANCE facilitate the implementation of NRT GEO aerosol data?



LANCE Formal Request Elements

- Abstract
- Identify and Summarize the effort
 - Who is requesting the effort
 - Who is completing the effort
 - Is there a HQ or Science Sponsor
- Scientific and and/or Application Objective achieved though Enhancement
 - Contributions to Science and *Applied Sciences* (applications)
- Concept of operations
 - Location of functionality
 - Development, integration and testing process
 - Funding: support (FTEs) for supporting effort
 - Available funds
 - Requested funds
 - What is the plan for approving the work is completed?
- Notional schedule
- Hardware cost implications
- Appendix: letters of support: ICAP members, perhaps WMO GAW Program (Greg Carmichael?)

